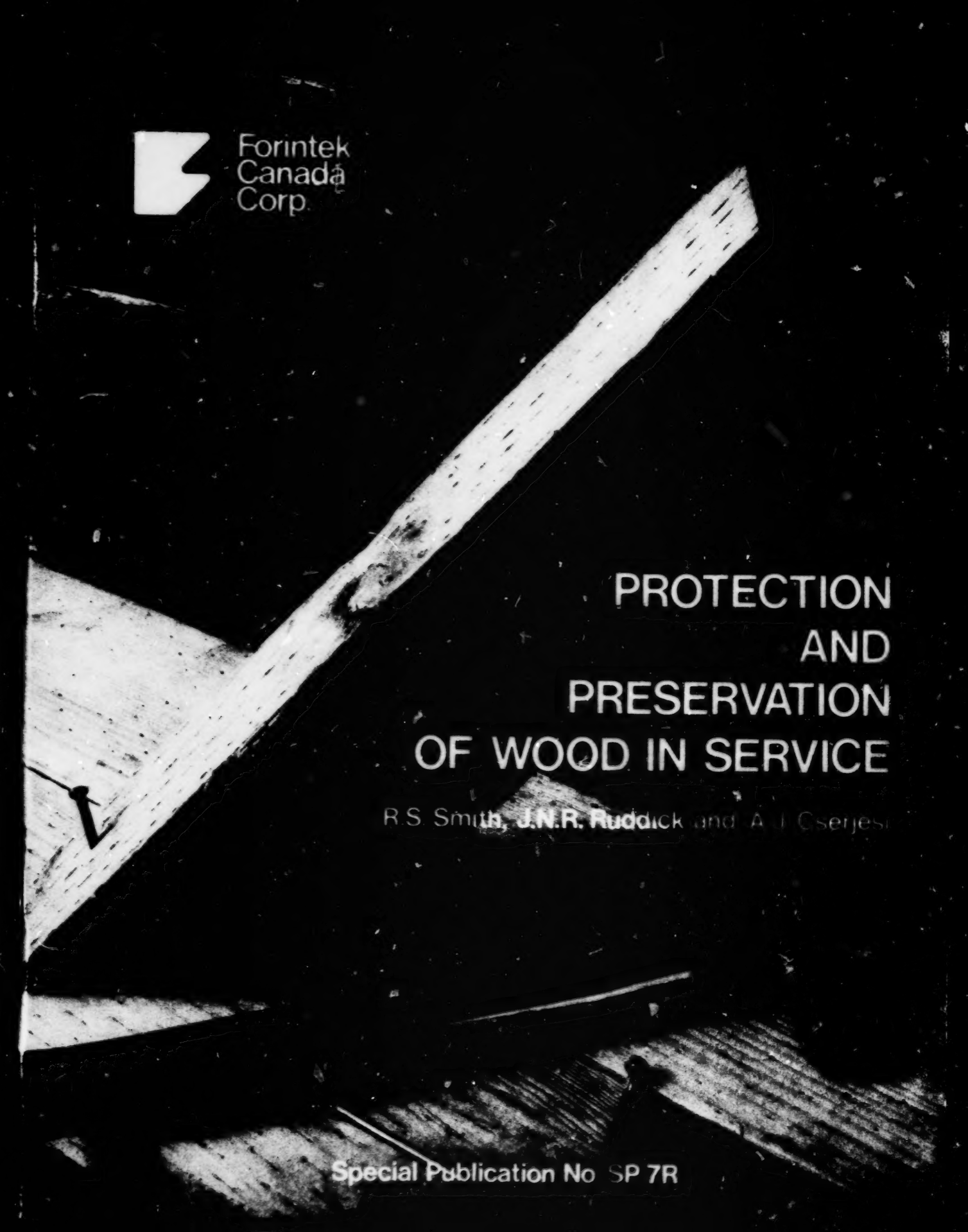

PROTECTION AND PRESERVATION OF WOOD IN SERVICE

R.S. Smith, J.N.R. Ruddick and A.J. Cserjesi

Special Publication No. SP 7R

WESTERN LABORATORY

The Western Laboratory, located at Vancouver, British Columbia, Canada, was formerly known as the Western Forest Products Laboratory, a branch of the Canadian Forestry Service, Environment Canada until April, 1979.

Effective April 1, 1979 the Laboratory became a research division of Forintek Canada Corp., a Canadian non-profit corporation.

The Laboratory has a staff of 110 actively engaged in work in a dozen scientific and technical disciplines. It is a problem-oriented organization that offers assistance and expert advice to the forest products industry, professional associations and consultants, provincial and federal government agencies, trade associations, equipment manufacturers, educational institutions and the general public. These services are offered with the objective of realizing the optimum benefit for Canadian society from one of the country's most important natural resources — its forests. The general area of responsibility of the Western Laboratory includes the four western Canadian provinces, the Yukon and Northwest Territories.

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PROTECTION AND PRESERVATION OF WOOD IN SERVICE:

QUESTIONS AND ANSWERS

By

R.S. Smith, J.N.R. Ruddick and A.J. Cserjesi

Special Publication No. SP 7R

Revision of
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ABSTRACT

Questions and answers relating to the following problems are discussed: lumber suitable for long service; discolorations on lumber and decay; wood rot, its recognition and prevention; construction of a long-service sun deck; protection of shingle and shake roofs; wooden boats and their protection; the repair of wooden steps and foundations; the protection of log cabins; the treatment of fence posts; what is treated wood, is it safe to use and where can it be purchased.

RÉSUMÉ

Les auteurs traitent de questions et réponses à propos des problémes suivants: le bois d'oeuvre durable; les colorations fongiques et la pourriture du bois; comment identifier et empêcher la carie du bois; la construction d'une terrace en bois qui durera longtemps; la protection des toitures en bardeaux ordinaires et en bardeaux de fente; la protection des bateaux de bois; la réparation des marches d'escalier et des fondations en bois; la protection des chalets en bois rond; comment traiter les piquets de clôture; qu'est ce que du bois traité contre la purriture, peut-on l'utiliser en toute sécurité, et où peut-on l'acheter?

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Introduction

by R.W. Kennedy*

Wood has been considered the world's most useful material ever since primitive man first used a wooden club in food gathering and for protection. It is one of our few renewable resources. It has natural properties so that it can be shaped and fastened for a variety of purposes and it is strong in relation to its weight. Wood is composed of a cellular structure of organic material formed during growth of trees which, not only supports stems and branches, but also provides a source of food for countless species of wood-inhabiting plants and insects. These insects and small plants attack both trees and manufactured wood products and, in time, reduce them to basic elements of the original forest environment. As man is concerned with functional use and appearance of wood, these attacks are considered as damage.

In Canada and in other temperate regions, most damage to wood products results from attack by specialized plants called fungi, which cause decay or rot. While insects cause significant damage in growing forests, they are of minor importance in Canadian wood products.

Fungi in wood get nourishment from wood cell walls and contents. They require air, which is normally present in the cells, a constant supply of moisture and prefer moderate temperatures. The body of a fungus, called a mycelium, is made of tube-like cells which develop within and upon damp wood, enabling the decay to spread rapidly under favorable humid conditions. Fungi also develop from spores (seed-like bodies) produced in millions from fungal reproductive structures sometimes called conks or mushrooms.

Wood varies in its ability to resist decay, the heartwood or central part of a log generally being the most durable portion, particularly for tree species, such as the cedars and oaks, which may give useful service for 15 to 20 years even when used in the ground where decay hazard is extreme. By contrast, the sapwood or outer band of wood next to tree bark is non-durable in the above and in all other tree species, and unless it is preservative treated, it should only be specified for use where the wood is to be kept dry.

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Wood that is kept dry (i.e. less than 20 percent moisture content) will not decay because, without sufficient moisture, it cannot support growth of fungi. Where the moisture content cannot be controlled, as in outdoor use in ground contact or in poorly ventilated, humid areas, the wood should be preservative treated for maximum service life.

In many cases, decay occurs in wood structures because of incorrect design and improper building practices. Adequate drainage and soil grading around a building should be specified, so that the site is dry and wood is not permitted to contact the ground. Wall cladding and roofing must be applied and maintained to shed water and to prevent wind-driven rain from entering a structure. Ventilation within the space in a building should carry off excess humidity and, with vapor barriers, should prevent condensation and wetting of wood within walls and enclosed spaces which could favor growth of wood-decay fungi.

In order to deal with these situations more specifically, they are examined in some detail in the sections which follow. Additional information on these and other matters dealing with the use of wood is available by contacting the Western Laboratory, Forintek Canada Corp., 6620 N.W. Marine Drive, Vancouver, B.C. V6T 1X2.

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Timber Frame House Construction. 1972. Council of Forest Industries of British Columbia. Vancouver, B.C.; 25 pages.

Vapour Diffusion and Condensation, by J.K. Latta and R.K. Beach. 1964. National Research Council of Canada, Division of Building Research, Canadian Building Digest 57, Ottawa, Ont.; 4 pages.

Q.1 How can I select suitable lumber for long service?

A. While cost is often the first consideration in selecting building material, the homeowner must also be concerned with strength, appearance and durability. Some of these qualities are difficult to recognize in lumber by casual inspection, but with the present system of grade stamping regulations, considerable information can be gained through study of these marks.

Since all construction lumber in the North American market is graded at the time of manufacture, each piece of planed dimension lumber now carries a code, stamped on one face, which notes the origin and identifies the timber species type, the grade of the piece and whether or not the piece was surfaced dry or unseasoned. For practical purposes, the higher grades are superior both in strength qualities and appearance. This material is more costly and is suited for load-bearing situations, such as beams and joists. The lower grades are intended for less exacting purposes, such as studding, plates, rafters, temporary low-cost construction, crating, sheathing, and blocking. These grades may also have poorer durability, as the characteristics permit a limited amount of unsound wood in the form of pockets of brown-cubical rot, which can advance further if used under conditions favoring decay.

Four species groups are identified. "W. cedar", including western red cedar and Pacific Coast yellow cypress or yellow cedar, identifies the most durable of Canadian timbers and is a logical choice for use where decay hazards exist and where the builder does not intend to apply preservatives. Yellow cedar is harder and holds nails better than western red cedar.

"D-fir-L" identifies Douglas-fir and western larch which, because of strength, is the most favored species group for heavy construction. Both species are moderately decay resistant and may be used untreated in many outdoor situations where wood is normally protected from the weather.

In the B.C. coastal region, "Hem-Fir" is most common and refers to western hemlock and the true firs, amabilis fir and grand fir. This lumber is second to D-fir-L in strength. Because the woods are not durable, this lumber should be used only in

situations where it is protected against the weather unless it is preservative treated.

In the B.C. interior regions, the most common species group is "S-P-F", signifying the spruces, lodgepole pine and alpine fir. This material is also frequently seen in construction at B.C. Coast sites and is largely used in light framing, studs and roof decking. The durability is similar to Hem-Fir lumber and if untreated it should also be protected against weather. Because it is frequently carried by truck or rail, the wood is usually dried to reduce weight. Lumber of all species stamped "Dry" is intended for interior use in buildings as flooring, doors and windows, shelving and trim. Because the wood has been kiln dried, additional shrinkage is minimized.

Unseasoned or "green" (stamped GRN) lumber is used widely in construction. It is more easily nailed than dry lumber and does not require covering at a building site, but allowances must always be made for shrinkage (when green lumber dries) and also to prevent warping in framing. During construction, care must be taken to see that the lumber is dry before it is enclosed in wall spaces and floors, since otherwise hazardous conditions for decay can develop during the life of the building.

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Native Trees of Canada, by R.C. Hosie. 1969 (7th ed.). Canadian Forestry Service, Queen's Printer, Ottawa, Ont., K1A 0S9; 380 pages.

Q.2 Does discoloration of lumber mean decay?

A. Discolorations in wood may result either from chemical reactions or as a result of growth of fungi. While any change in color may be objectionable if the wood is used for decorative purposes, not all discolorations signify that the wood is otherwise degraded.

Wood-inhabiting fungi may be separated into three groups: decay fungi, sapstain fungi and moulds. This separation is based on the fungal effect on wood, which is in turn the result of how the fungi obtain nutrients for their growth. Decay fungi utilize both soluble materials (called wood extractives) and structural components of wood cell walls. The latter are degraded to simple compounds to make them available as fungal nutrients. Degradation of structural components seriously affects the strength of wood.

On the other hand, moulds and sapstain fungi utilize only certain wood extractives. Since they do not degrade any structural wood components, the strength of lumber is not significantly affected by their growth. Moulds utilize extractives conducted to the surface by water during drying and, therefore, they grow only on the surface of lumber. Sapstain fungi grow on the nutrients present in storage cells in sapwood, so their growth is restricted mainly to sapwood.

The location of discoloration caused by these fungi obviously reflects their feeding habits. Moulds cause only surface discolorations of random shapes, due mainly to the color of their spores or spore-bearing structures. The discoloration can be almost any color, from white to black, and can be removed by resurfacing lumber. Discolorations caused by sapstain fungi often form radial streaks in wood. The most common discoloration caused by these fungi is dark gray or bluish black, which is due to the appearance of their colored mycelium within the wood.

Decay fungi may discolor any part of wood. Such discoloration is due to the reaction of the fungi with the wood components and not to the color of the fungi themselves. In softwoods, the color is reddish brown or, occasionally, purple at the early stage of decay. Softening of the wood, which is an obvious sign of decay, can be observed

by pushing a sharp object, like a knife or screwdriver, into parts of the wood suspected of decay and comparing this with sound wood. However, early stages of decay may not appreciably soften the wood, but will render it somewhat brittle. This can be detected using a sharp-pointed tool and levering splinters of the wood up from the surface. Any type of brash break, as opposed to a splintering failure, would suggest early stages of decay and serve to distinguish this from fungal stain.

Chemical reactions may also cause discoloration on wood. Western hemlock and other wood species may have a dark-brown discoloration in sapwood, especially on the end grain. This discoloration is due mainly to some extractives being translocated to the surface during drying and later oxidized to dark brown material. Black or dark gray discolorations (sometimes pink on yellow cypress and on western red cedar) can be found on lumber, caused by the reaction of wood extractives with iron. These discolorations are superficial and do not otherwise affect wood properties.

In summary, discolorations caused by chemical reactions and by moulds are restricted to the surface (less than 1-mm penetration), while sapstain fungi may color sapwood a bluish or grayish black. These are not signs of decay. If obvious signs of decay (softening of wood) are not present, any other change in color may indicate decay, but a positive answer can be given only by laboratory examination.

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Staining of Wood and Its Prevention, by R.D. Graham and D.J. Miller. 1967 (revised). Oregon State University, Forest Research Laboratory Special Report 2, Corvallis, Ore.; 11 pages.

Wood Chemistry of Western Conifers – Questions and Answers, by G.M. Barton. 1973. Environment Canada, Canadian Forestry Service, Western Forest Products Laboratory Information Report VP-X-106, Vancouver, B.C.; 28 pages.

Q.3 How can I recognize rot and where can I expect it?

A. Decay results from attack by micro-organisms called fungi which obtain food from wood and, in doing so, destroy the wood structure. As far as the homeowner is concerned, rot or decay is a condition causing wood to be soft, crumbly and weak and incapable of holding nails.

Attack may start with germination of spores of the fungus upon moist surfaces which start the decay process in unprotected wood. Fungi may attack trees, logs or products made from wood. Sometimes lumber may be partially decayed at the time it is sawn but, for the most part, rot is eliminated by further trimming or the lumber is relegated to a low grade.

The most common form of decay seen in fresh-sawn lumber is called white speck or honeycomb and it appears as a series of white pits or spots in streaks or in general areas in heartwood. Where relatively small areas are affected, the strength of a piece is not seriously reduced and this type of material is commonly used. The fungi concerned do not advance further once the wood is dry.

Other forms of rot, often with pockets of unsound wood in small brown or black cubes, usually weaken lumber excessively. As in the previous case, if wood is kept dry, rot of this brown-cubical type will not advance. If moisture remains in the wood, however, this type of decay can develop further and cause serious damage. Most of these fungi can only be eradicated by kiln drying the lumber.

In stored, unseasoned lumber or in damp buildings, decay may spread from contact with the fungus in an adjacent board or when wood contacts moist soil, which is an abundant source of infection. Once established, decay can spread rapidly where conditions are warm and humid, particularly in non-durable timber species like the spruces, pines and western hemlock. In early stages of an attack, decay may not be apparent and the wood can still be hard, although subsequently it becomes progressively weaker. In the process of decay, because water is produced by a fungus, the moisture content of the wood can increase. If the wood is painted, blisters may appear in the paint film, ex-

— ARE YOU SURE THERE ISN'T A BETTER WAY TO SOLVE THE WORLD FOOD CRISIS ?

posed nail heads may rust and the wood may show irregular dark streaks as decay advances.

As a general rule, decay problems can be expected in buildings wherever dampness occurs, either from faulty roofs, leaking drain pipes and plumbing or in foundations where soil is allowed to touch untreated wooden plates, siding or posts. Decay also may develop within wall spaces and attics where vapor barriers are incorrectly placed on the cold side of the insulation and condensation of moisture from the living quarters of the house occurs. Once water droplets form, these will wet the wood and favor attack by fungi.

Where decay is present in enclosed areas, such as in walls, under porches, in crawl spaces or in unoccupied rooms without ventilation, a characteristic odor may be detected. Within damp walls or where flooring or plywood contacts joists or plates, patches or sheets of gray-white to yellow-colored mycelium may appear on the wood surface. Certain fungi develop strands of mycelium which spread like a fan, while others produce miniature mushrooms. By this time, decay is usually well advanced and brownish areas of soft, crumbly rot are present which can be detected when wood is probed with a knife. Floors and counters may sag through failure of the joists and framing. Often at this stage, carpenter ants and termites appear, attracted by the rotted wood, particularly in wall plates and ends of posts.

Because of the nature of wood and the design of wood structures, however, it is extremely rare for an abrupt failure to occur in everyday use. The homeowner normally has considerable advance warning of decay problems and can take steps to repair damage before there is danger of collapse.

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Decay in Buildings; Recognition, Prevention and Cure. 1969. Ministry of Technology, Forest Products Research Laboratory, Technical Note Number 44, Princes Risborough, Aylesbury, Bucks., England; 17 pages.

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Vapour Diffusion and Condensation, by J.K. Latta and R.K. Beach. 1964. National Research Council of Canada, Division of Building Research, Canadian Building Digest 57, Ottawa, Ont.; 4 pages.

Q.4 How can the spread of existing decay be prevented?

A. The decay of wood by fungi cannot occur if the wood is dry. Therefore, the easiest control measure to apply, should the decay of wood work be observed, is to dry the wood by suitable ventilation and heating. However, it should be remembered that wood-destroying fungi can remain alive but inactive in dry wood, often for many years. Subsequent rewetting of such contaminated wood will quickly revive the wood-destroying fungi, resulting in further decay. This means that remedial measures to correct for decay preferably should involve the removal of all wood showing visible signs of decay, cutting out all wood work for two feet beyond all visible signs of decay or fungal growth. This is the most desirable procedure.

Both very high temperatures [above 45°C (95°F)] and those below freezing will prevent the development of decay in wood, but in practice such treatments are not generally applicable.

The use of fungicides on wood to kill existing wood-decaying fungi, and also to prevent subsequent reinfection in the wood, can be reasonably effective. However, the penetration of wood-preservative solutions into wood is generally difficult and a brush application onto the surface of most building lumber barely penetrates the surface. Therefore, such a treatment is ineffective in controlling decay already present within wood. Its primary value is as a partially effective preventive measure, controlling the attack of undecayed wood by fungi. The best treatment for replacement lumber to prevent its decay is by commercial pressure treatment with a suitable wood preservative (pentachlorophenol, creosote or chromated copper arsenate) thereby achieving a deeper penetration of the toxic chemical within the wood.

Since some woods have natural durability or resistance to fungal decay (western red cedar, yellow cedar, Douglas-fir, white oak, teak), preference should be given to using these species, particularly where decay is obviously a possibility.

In summary, the correct procedure to limit existing decay is as follows:

1. Remove all visibly decayed wood and wood two feet beyond visible decay;

2. Dry the wood work and surrounding environment;

3. Treat replacement wood work (preferably by a pressure treatment) with a suitable wood preservative;

4. If possible, use a wood having some natural durability in preference to other common constructional woods which have no natural durability.

Further Reading

Principles for Protecting Wood Buildings from Decay, by T.C. Scheffer and A.F. Verrall. 1973. United States Department of Agriculture, Forest Products Laboratory, Research Paper FPL 190, Madison, Wis.; 56 pages.

Q.5 How should I plan a sundeck to give me long service?

A. Outdoor living, as part of the West Coast life style, is so important that large expanses of deck are now constructed around our homes to increase summer living space. Wooden support structures provide the basis for a platform system of lumber or plywood, now frequently finished with a neoprene-hypalon or a "fibre-glass" surface for longevity. Surrounding the platform or deck is a railing system for safety. Such a structure could and should last for at least 50 years with a minimum of maintenance. All too frequently, however, we are faced with a rotten and collapsing structure before the first decade has passed. These failures are generally blamed on the poor quality of the wood, and expensive renovations are undertaken with no guarantee of any longer life for the replaced structure.

Such expensive problems need not occur if chemically pressure-treated wood is used, treated according to the Canadian standard, CSA 080 – Wood Preservation. In building a deck for the future, the following guidelines are helpful:

Vertical support posts:

These are frequently in ground contact or on concrete bases that allow wetting of the base of the posts. The lumber must be incised with small slits and pressure treated with chromated copper arsenate (CCA), ammoniacal copper arsenate (ACA) or pentachlorophenol (PCP) wood preservatives to a retention of 0.4 lb/cu.ft., according to CSA 080. After treatment, no trimming of these posts is allowed at the bottom ends in contact with the ground or a concrete base.

Horizontal superstructure excluding deck surface and railings:

This should be constructed only from lumber pressure treated with CCA, ACA or PCP to a retention of 0.25 lb/cu.ft. There should be a minimum of cutting after preservative treatment. The lumber could be incised or unincised depending on appearance requirements.

Deck surface and railing system:

Only to be constructed from pressure-treated lumber using CCA or ACA at a retention of 0.4 lb./cu.ft. Incised lumber is preferred, although some surface splintering may result from this and

be unacceptable. If plywood is used, irrespective of the final finishing membrane, this should be pressure-treated with CCA or ACA to a retention of 0.4 lb./cu.ft. Any trimming of the deck members after treatment should be avoided. It will be helpful to remember the following points:

1. Always obtain your pressure-treated lumber from a reputable source with a guarantee of treatment to CSA 080 standards.
2. Use only lumber and plywood that has been kiln dried to less than 19% moisture content after pressure treatment.
3. Use coastal Douglas-fir, western hemlock, true fir, or western red cedar.
4. Where cutting or trimming of the treated lumber or plywood has been necessary, brush treat the cut surfaces with two coats of a suitable field-cut preservative (see Forintek sheet no. SS-1002).
5. Use only hot-dipped galvanized nails or other galvanized fasteners throughout the structure, since some corrosion of iron will occur due to the CCA or ACA treatment.

A reasonable compromise to reduce construction costs would be to use untreated decking, but a homeowner should specify treated wood for all posts, joists and beams, also for railings, steps and stair framing, because they are the more difficult parts to replace. Over a term of eight to ten years, however, cost of repairs to decking and the inconvenience probably far outweigh the original advantage gained in using untreated wood.

Basic construction details should be observed for both treated and untreated wood. Concrete footings must be clear of the ground, with the top sloped to drain water. Joints and fastenings should be caulked to seal against water and only galvanized nails and bolts should be used.

Steps, preferably, should be open framed, but if enclosed they must be provided with screen openings situated to allow air circulation and to keep out insects.

Framing must be clear of ground contact and shrubbery must be spaced so as not to impede air movement.

Whether spaced decking or continuous decking (painted plywood or plasticized coatings over lumber) is specified, sometimes depends upon the situation of the sundeck or porch. Where coatings for continuous decking have been used, however, manufacturers' claims for complete waterproofing of wood have not always been realized in long-term service. Localized failures in the protective coating have resulted, either from improper application or poor maintenance. These have allowed rain to penetrate the finish which has been followed by decay in wood within the enveloping coat.

As a general rule, spaced decking has given the longest service life. It allows drainage between boards and maximum ventilation and drying of the wood and, if replacement is required, only small portions of the surface need be repaired at one time.

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Preservatives Used in Home and Garden. 1980. Forintek Canada Corp., SS-1002, Vancouver, B.C., V6T 1X2; 1 page.

Q.6 How long should my shingle or shake roof last?

A. A properly constructed shingle or shake roof will combine a long and reliable service life with considerable decorative and aesthetic appeal. However, under conditions of moderate decay hazard, which prevail in many areas of the Pacific Northwest, additional chemical treatment of the shingles or shakes is required to achieve maximum service life.

Western red cedar, the major wood species used for shingle and shake roofs, is classified as a durable wood. However, practical experience indicates that in climatic zones of moderate decay hazard, such roofs may undergo serious decay in a period of 10 to 15 years. Western red cedar is known to be very variable in its durability characteristics, with the inner heartwood and the sapwood being low in durability. As a consequence, sapwood is not allowed in commercial shingle grades. Selection of shingles and shakes for durability based on color is often suggested, but practically there is little reliable basis for such a selection.

The actual service life of a specific shingle or shake roof will depend on many factors other than the durability of the original wood. The thicker the wood, the longer it will last; the steeper the roof pitch and the better the ventilation of the roof, the longer it will last. A prolonged damp situation, caused by overhanging trees, will undoubtedly accelerate decay. Similarly, the growth of mosses and lichens on the roof surface and the blockage of the channels between the shingles or shakes by leaf debris will increase the rate of degrade of the roof. The practice of building a shingle or shake roof on top of a solid plywood base, often required to prevent wind-driven snow passing into the attic, also will result in an accelerated rate of decay and shorter roof life.

There is some practical evidence to suggest that swabbing down or coarse-spraying a shingle or shake roof every five years with a suitable fungicide will increase the service life of that roof. Five-percent pentachlorophenol or one-percent copper or zinc naphthenate as the active ingredient in heavy oil would be suitable for such treatment. As these chemicals are toxic to both humans and plants, extreme care should be exercised in their use (see Question 12).

—PROTECT YOUR ROOF, PROTECT YOUR FAMILY!

Ideally, shingles or shakes pressure treated with a suitable wood preservative, e.g. chromated copper arsenate (Boliden or Wolman salts), should be used in initial construction. Such a treated roof should provide a service life well in excess of 30 years, if it is carefully constructed following the standard CSA 0118.1 – M1980. At the present additional cost of about 20 percent over the cost of untreated shingles or shakes, the use of pressure-treated shingles or shakes represents an excellent investment for home owners and will provide an attractive roof which will considerably outlive roofs made with many synthetic materials.

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Western Red Cedar Shingles, Handsplit Western Red Cedar Shakes and Machine-Grooved Shakes. 1980. Canadian Standards Association, CSA Standard 0118.1, 178 Rexdale Blvd., Rexdale, Ont. M9W 1R3.

Your Roof is an Investment Tool 1980. Forintek Canada Corp., SS-1003, Vancouver, B.C. V6T 1X2; 1 page.

Q.7 Should I build a wooden boat?

A. Historically and traditionally until recently, wood has been the most widely accepted material for boat construction. When correctly selected for species and grade, it provides a very flexible and durable constructional material, which has excellent strength properties for its weight. Wooden boats do not give the "sweating" (condensation) problems common to concrete and steel boats. They also have the advantage of easy finishing and modification without the problems of pre-drilling and plugging required for concrete and steel construction.

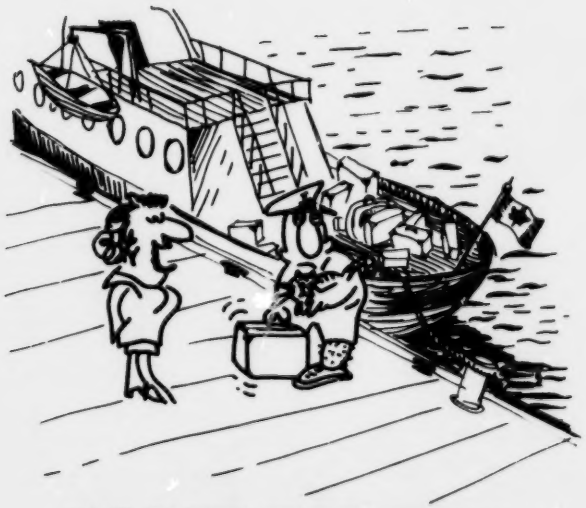
Wooden boats will give excellent service if some care has been exercised in their original construction. Commonly "bending oak" is used for the framing, but such oak can be either red or white oak and these two species groups differ markedly in their resistance to fungal decay. White oak heartwood generally will give twice the service life of red oak heartwood under average conditions. However, the use of red oak, pressure treated with a suitable wood preservative (chromated copper arsenate, Boliden or Wolman salts), will give a service life equal to or better than untreated white oak.

Untreated sapwood of all wood species must be avoided because of its lack of resistance to decay. Also the inner heartwood (boxed heartwood) of trees should be avoided wherever possible, again because of its often poor durability.

Durable or very durable woods [e.g. white oak, western red cedar, yellow cedar, Honduras mahogany (or equal), teak] must be used where the decay risk is high, although less durable species can be used if they are pressure treated with a suitable wood preservative. The choice of wood species is often controlled by cost and availability but service life depends largely upon this choice.

The use of decayed or otherwise unusually stained wood in construction should be avoided. Not only could such wood be lower in strength than expected, but it could harbor wood-decaying fungi which, under damp conditions, would continue to decay the wood.

Good ventilation must always be provided



— I AM NOT SETTING FOOT ON THAT THING UNLESS IT'S A PRESSURE TREATED WOODEN BOAT!

within the hull and, to ensure that the hull is water-tight, fungicidal mastics must be used during construction, particularly at the plank shear. In those parts of boats where fresh-water seepage or condensation seems unavoidable, the use of pressure-treated wood or wood with very high natural durability is essential.

Finally, a good organic-solvent wood preservative (pentachlorophenol, copper or zinc naphthenate) must be liberally applied to all cut surfaces, especially cross-cut and exposed end grain and drilled holes, where the decay hazard is high.

Further reading

Prevention of Decay of Wood in Boats, by J.G. Savory and D.F. Packman. 1954. Department of Scientific and Industrial Research, Forest Products Research, Bulletin No. 31. Her Majesty's Stationery Office, London, England; 18 pages.

Red and White Oak in Boat Construction, by R.S. Smith. 1966. Western Fisheries 73(2): 31 – 33, 77 – 82.

Timber in Boat Building, by J.H. Heath and W.J. Read. 1977. Forestry Commission of New South Wales, Technical Publication No. 5, Sydney; 22 pages.

Wood: A Manual for Its Use as a Shipbuilding Material (2 volumes). 1957. Bureau of Ships, Department of the Navy, U.S. Government Printing Office, Washington, D.C.

Q.8 How can I repair steps and wooden foundation members?

A. Decay in wood cannot take place unless the wood contains a suitable amount of moisture. If wood shows free water on the surface, or wood feels damp to touch, then the wood certainly is wet enough for decay to occur. However, wood can feel dry on the surface, but it may be quite wet inside and suitable for the growth of wood-decaying fungi.

Wooden steps and ground-contact foundation members often decay in service because of poor initial building practices which failed to take into account the need to keep wood dry. Repairs initially should attempt to rectify any poor construction, thereby providing a drying trend for the existing wood. By the use of suitable membranes, e.g. 45-lb. asphalt-roll roofing or 6-mil polyethylene sheet, the direct contact of wood with the ground (soil, concrete, etc.) can be avoided. Steps can often be protected from rain wetting by suitable design, which would certainly prolong their service life.

Joints between steps and stringers or railings are potentially high decay-hazard areas because of the exposed end grain and the cracks created to trap water. By suitable design, or the use of fungicidal mastics and preservative solutions, such hazards can be minimized.

Existing decay should be recognized and all wood members cut back at least two feet beyond such visible decay. Replacement lumber should be carefully selected to be free of decay, to be adequately dried and preferably pressure treated with a suitable wood preservative (e.g. pentachlorophenol or chromated copper arsenate). Only by pressure treatment of wood with a preservative can a sufficient depth of penetration be achieved to adequately protect wood when it is used in a high decay-hazard situation. Any cutting of treated wood, subsequent to its treatment, will expose internal untreated wood and such exposed surfaces must be liberally brush coated with an organic solvent type of wood preservative (pentachlorophenol, copper or zinc naphthenate) for their protection. Most preservative formulations of the types suggested subsequently can be painted over and, therefore, do not interfere with the appearance of a house.

Should pressure-treated wood be unobtainable, then soaking of the replacement wooden members by overnight submersion in an organic-solvent type wood preservative (containing pentachlorophenol, copper or zinc naphthenate) will give reasonable protection from decay. However, the treated wood should be allowed adequate time to dry out before being installed.

The use of synthetic plastic-based finishes are often advocated for outside steps and decks. While such materials are excellent in keeping water out, they function equally well in keeping water in the wood and preventing any drying out. Any failure of the treatment initially to keep water out could result quickly in a very serious decay situation. The use of flexible-plastic and neoprene-coating materials is desirable for wood where some expansion and contraction is inevitable.

Further Reading

Principles for Protecting Wood Buildings from Decay, by T.C. Scheffer and A.F. Verrall. 1973. U.S. Department of Agriculture, Forest Service, Research Paper FPL 190, Forest Products Laboratory, Madison, Wis.; 56 pages.

Q.9 How should I build my log cabin to protect it from decay?

A. I *Cabin Not Yet Constructed:*

The best protection for a log cabin is to construct it properly so decay hazards are minimized. This means building so that no untreated wood is in ground contact or is allowed to collect moisture. Some design criteria that should be followed include building on a one or two-foot-high foundation of concrete or brick, constructing the roof with a large overhang, properly installing eaves troughs and downpipes, and sloping the ground away from the cabin.

For maximum durability, the logs should be preservative treated. Pressure impregnation by a commercial treating company provides the best treatment, but is also the most expensive. Treating methods that can be accomplished by a cabin owner include soaking or steeping freshly cut or dry logs in copper sulphate or chromated zinc chloride solutions, soaking peeled and relatively dry posts in pentachlorophenol, copper naphthenate or creosote solutions, and brushing these and other preservative solutions onto wood surfaces.

The importance of properly drying logs before erecting a cabin should be emphasized. When they dry, the logs crack open; these checks often extend below the preservative treatment, providing avenues for fungal infection or insect attack. Also, they can trap moisture, making the wood more prone to decay. One interesting and apparently effective procedure for controlling this checking is to run a saw cut or kerf down the length of logs before preservative treatment. The kerf relieves drying stresses, so natural checks are less likely to occur and, since the kerf is treated, decay organisms don't have access to untreated wood. The saw kerf should extend right to the pith of a log or it will deepen on drying and expose untreated wood. A kerfed log should be placed with the saw cut down so it doesn't trap water.

II *Cabin Already Erected:*

The useful life of cabins can be extended somewhat by regular brush application of an oil-borne preservative or preferably of a water-repellent preservative finish. An effective natural finish

can be made by dissolving one pint of 10:1 pentachlorophenol preservative concentrate, 1/2 pint of ground-in-oil pigment, and 3 oz. of paraffin wax in one gallon of boiled linseed oil. There are also several penetrating preservative stains available which are not oily and can be painted over.

Further Reading

A Simple Natural Finish for Exterior Siding, by F.W. King and T.S. McKnight. 1969 (reprinted). Department of Fisheries and Forestry, Canadian Forestry Service, Publication Number 1136, Ottawa, Ont.; 4 pages.

An Easy Way to Preserve Fence Posts by Sap Displacement, by J. Krzyzewski. 1964. Canada Department of Forestry, Forest Products Research Branch, Publication Number 1076, Ottawa, Ont.; 10 pages.

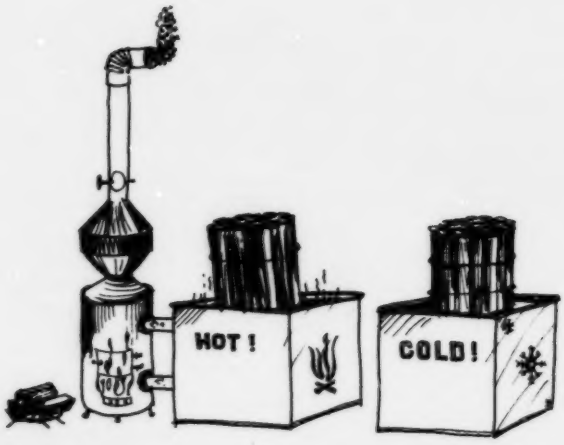
Wood Preservation Around the Home and Farm, by H.P. Sedziak. 1969. Department of Fisheries and Forestry, Canadian Forestry Service, Publication Number 1117, Ottawa, Ont.; 15 pages.

Q.10 How can I treat fence posts with preservatives at home to extend their lives?

A. Under most climatic conditions, untreated fence posts of such non-durable species as spruce or pine will last only two to five years, but this service life can be extended considerably by using one of several treating procedures.

Probably the most effective means of treating posts, without using pressure, is by the hot-and-cold bath treatment using an oil-based preservative, such as creosote, copper naphthenate in oil or pentachlorophenol in oil. The procedure is to place the posts (usually just the butt area that will be in ground contact) in hot preservative for several hours; then either allowing the preservative to cool, with the posts still immersed in the preservative, or quickly transferring the posts to a tank of cold preservative. Alternatively, some protection can be given to wood by soak, dip or brush treatments with creosote, copper naphthenate or pentachlorophenol solutions. For all of these treatments, posts should be well seasoned prior to treatment. Preservatives can penetrate sapwood easier than heartwood, so round posts having an intact sapwood band will treat better than sawn posts.

There are several means of treating posts at home with water soluble preservatives. The simplest procedure is to steep or soak posts in water solutions of such chemicals as bluestone (16 percent solution) or chromated zinc chloride (5 percent solution). Either green or dry posts can be treated in this way. If unseasoned posts are used, complete sapwood penetration can be achieved by setting posts upright in pails of preservative solution; the chemical diffuses through the moisture in the wood to the top of the posts. Since the salts used are water soluble, the preservative will be leached or washed out of posts with time.



A longer-lasting treatment can be achieved by the double-diffusion process. Posts are steeped in one solution for several hours and then placed in a second solution. The chemicals react in the wood to form a non-water-soluble salt that will not be washed out readily. A typical double-diffusion treatment is to soak wood in a 12-percent copper sulfate solution for one day, followed by one day in a 20-percent sodium chromate solution. Metal tanks should be lined with polyethylene to prevent corrosion by the copper sulfate. These chemicals

are available from industrial and agricultural chemical-supply companies; in 1980, both chemicals sold for about $100 per 10 kg.

Further Reading

An Easy Way to Preserve Fence Posts by Sap Displacement, by J. Krzyzewski. 1964. Canada Department of Forestry, Forest Products Research Branch, Publication Number 1076, Ottawa, Ont.; 10 pages.

Field Evaluation of Fence Posts Creosoted by the Thermal Process, by J. Krzyzewski. 1969. Department of Fisheries and Forestry, Canadian Forestry Service, Forest Products Laboratory, Information Report OP-X-25, Ottawa, Ont.; 18 pages.

The Double-Diffusion Method of Treating Wood: A Review of Studies, by R.H. Baechler and H.G. Roth. 1964. Forest Products Journal 14(4): 171 – 178.

The Preservative Treatment of Fence Posts by Non-Pressure Processes, by H.P. Sedziak. 1962 (revision). Canada Department of Forestry, Forest Products Research Branch, Bulletin Number 107, Ottawa, Ont.; 24 pages

Wood Preservation Around the Home and Farm, by H.P. Sedziak. 1969. Department of Fisheries and Forestry, Canadian Forestry Service, Publication Number 1117, Ottawa, Ont.; 15 pages.

Wood Preservation on the Farm, by D.J. Ormrod and B.E. Baehr. 1978. B.C. Ministry of Agriculture, Parliament Buildings, Victoria, B.C. V8W 2Z7; 10 pages.

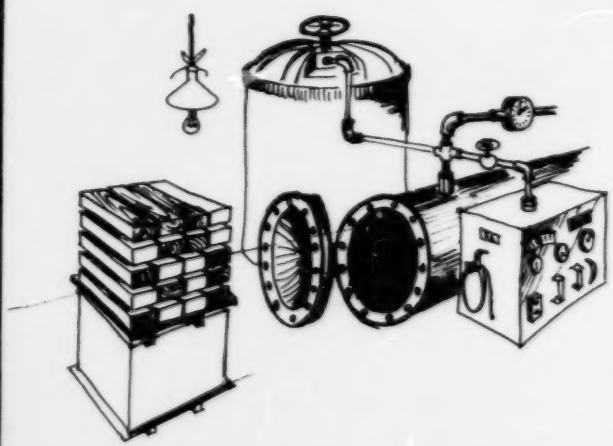
Q.11 What is "treated wood"?

A. The commonly available preservative chemicals for wood are about equally toxic to decay fungi, if they are used at the recommended concentrations. Thus, preservatives or preservative-treated wood can be chosen on the basis of cost of treatment, appearance, safety and weatherability.

Creosote, pentachlorophenol and copper or zinc naphthenate preservatives are available in small quantities for home use at hardware stores, lumber yards and building-supply stores. Creosote and pentachlorophenol are also used for the pressure treatment of wood, creosote being the best known preservative. Creosote is fairly economical and easy to apply by brushing or dipping; however, it has a strong odor, is oily and cannot be painted over and can cause painful burns, if it gets on skin on a sunny day.

Five-percent pentachlorophenol solutions in petroleum oil or in a light solvent, such as kerosene, are about as toxic to decay fungi as creosote. Wood treated with oil-borne pentachlorophenol is dark brown and cannot be painted, whereas wood treated with light solutions can be painted as soon as the solvent has evaporated from the wood surface.

Copper naphthenate dissolved in a light solvent at a concentration of 0.75 percent copper is similar in effectiveness to the previously mentioned preservatives. Wood treated with this preservative is colored bright green, but it can be painted. Zinc naphthenate is somewhat less effective than copper naphthenate against decay fungi, but it has the advantage of leaving wood a more natural color.



The waterborne preservatives chromated copper arsenate (CCA) and ammoniacal copper arsenate (ACA) are always applied using pressure and are not available for home treatment. These preservatives are effective, even in ground contact and other wet conditions, as they react in wood to form non-water-soluble compounds. Wood treated with these preservatives is colored green and is clean and paintable. The CCA treatment may be sold under one of the following trade names: Ascu, Boliden K-33, Celcure A, Eradith Greensalt, Tanalith C or Wolman CCA; ACA is commonly called Chemonite.

The water soluble preservatives copper sulfate (bluestone) and chromated zinc chloride are not as effective as the "fixed" waterborne preservatives, as they can be washed out of the wood in service. However, they are readily available and can be used by a homeowner.

The effectiveness of the treatment with any preservative depends on the treatment method. The deepest and heaviest treatment is obtained with pressure impregnation and when such wood is certified to meet Canadian Standards Association wood-preservation specifications a maximum service life is ensured. Other much less effective means of treating wood are by cold soaking, cold dipping and brushing.

These non-pressure treatments will all extend the durability of wood used above ground considerably. However, the life of wood in ground contact may be extended by only one to three years when brush or dip treatments are applied, as compared with more than 30 years when pressure treatment is used.

Further Reading

Preservatives Used in Home and Garden. 1980. Forintek Canada Corp., Western Laboratory, SS-1002, Vancouver, B.C., V6T 1X2; 2 pages.

Preserving the Wood in Your Home, by J.N.R. Ruddick. 1980. Forintek Canada Corp., Western Laboratory, IB-1002, Vancouver, B.C., V6T 1X2; 4 page folder.

Wood Preservatives, by J.N.R. Ruddick. 1977. Presented at Forest Utilization Symposium, Winnipeg. Forintek Canada Corp., Western Laboratory, Special Publication No. SP 6, Vancouver, B.C., V6T 1X2; 15 pages.

Q.12 Is it safe to use wood preservatives?

A. Wood may be treated at commercial treating plants or at the site where it is to be used. Commercial pressure treatment is better than on-site treatment because it forces the chemical deeper into the wood. However, if pressure-treated timber is not available, a brush or dip treatment with a preservative solution at the site of construction can add years to wood's service life.

All chemicals used to protect wood against deterioration are toxic to humans. Three kinds of preservatives are generally available for home use. Creosote and copper or zinc naphthenate are regarded as "moderately toxic" and pentachlorophenol as "toxic" chemicals to humans. Pentachlorophenol is very toxic to fish and therefore caution should be exercised to avoid spills into waterways.

In addition, some water-soluble inorganic chemicals are also used to preserve wood. These chemicals may contain copper, chromium, arsenic, zinc, boron or mercury. Most of them are not available to the general public, mainly because they are "toxic" or "highly toxic" to humans, either by consumption or inhalation.

Since all these chemicals are toxic compounds, any accidental consumption of preservative can be fatal. Washing hands before eating or smoking is essential. In addition, although very small amounts of these chemicals escape into the air from the solutions at normal temperatures, they should be used only in well-ventilated areas. As some solvents are volatile, ventilation is also a recommended practice for fire safety and is even more important when a heated solution is used.

Most of the toxic compounds in oil solution (especially pentachlorophenol) can penetrate through skin. Prolonged contact of bare skin with these solutions may result in poisoning. Therefore, wearing plastic-coated or rubber gloves and aprons is required when working with these preservatives. Safety recommendations found on the label of these products should be followed and it is advisable to read them before opening the packages.

Preservative-treated wood (commercial or on-site treated) contains relatively small amounts of

toxic chemicals. It is very unlikely that any poisoning will occur from the consumption of treated wood (some people chew splinters). Although regular use of preservative-treated wood is safe, treated wood should not come in contact with food, even if poisoning is unlikely to occur (safety regulations exist for commercial companies in this respect). Because all of the wood preservatives are toxic to agricultural crops, wood treating should be carried out away from gardens. Copper and zinc naphthenate can be used for plant containers, but the solvents must be evaporated before use. Pressure treatment of wood with copper and/or copper and arsenic-containing preservatives is recommended for greenhouse construction. Pentachlorophenol should not be used for this purpose.

Very small amounts of pentachlorophenol escape from treated wood and in enclosed areas its concentration in the air may reach the toxic limit for both humans and plants; so that it is not to be used for non-ventilated areas.

Further Reading

Preservative Treatment of Greenhouse Wood, by G.A. Duncan and J.N. Walker. 1973. University of Kentucky, College of Agriculture, Cooperative Extension Service, Publication Number AE N-6, Lexington, Ky.; 5 pages.

Responsibilities and Risks Involved in the Use of Wood Protecting Chemicals, by R.S. Smith. 1970. Canada Department of National Health and Welfare, Occupational Health Review 21 (3/4): 1 – 6, Ottawa, Ont.

The Safe Use of Wood Preservatives, by D. Boocock. 1965. British Wood Preserving Association, News Sheet Number 55, London, England; 4 pages.

Toxic Hazards from Wood Preservatives, by J.M. Barnes. 1970. British Wood Preserving Association, Record 1970 Annual Convention: 129 – 142, London, England.

Q.13 Where can I buy pressure-treated wood?

A. For a long and economical service life, wood placed in ground contact or in other moist situations should be pressure treated. Fortunately, a homeowner, particularly in urban areas, should have little difficulty finding a supply of pressure-treated wood.

Some treating plants maintain a supply of treated wood and sell it in almost any quantities; others have a minimum order, usually of $50.00 to $200.00. Smaller plants will do custom work, treating to order small consignments of wood. Plants using large-capacity retorts usually cannot do this, as only wood of uniform moisture content and treating properties should be treated together.

In areas where there is sufficient demand for treated fence posts and lumber, building-supply stores, co-operatives and lumber yards will frequently stock treated wood products.

If you wish to purchase a small quantity of treated wood, you should first enquire at local building-supply stores. If this fails, contact the closest treating plant for information on their sales policy and distributors.

When purchasing pressure-treated wood you should specify whether it is for use in ground contact (e.g. fenceposts) or above ground (e.g. decking) and ensure that the preservative used is suitable for the intended end use. You should also determine that the wood has been treated according to Canadian Standards Association specifications.

At the end of this booklet there is a list which represents, to the best of our knowledge, the treating plants located in western Canada, their principal products and types of preservative used and their policies on selling treated wood.

Further Reading

Architectural Opportunities Seminar — The Use and Misuse of Wood in Construction and Architectural Design, edited by F. Alan Tayelor. 1974. Environment Canada, Canadian Forestry Service, Western Forest Products Laboratory, Information Report VP-X-123, Vancouver, B.C.; 41 pages.

Pressure Treated Timber. 1971 (2nd ed.). Canadian Institute of Timber Construction, Ottawa, Ont.; 40 pages.

Q.14 How do I use pressure-treated wood?

A. The preservative-treated lumber and plywood which you buy contains chemicals specially designed to prevent it from rotting or being eaten by insects. Although this chemical has been placed in the wood under high pressure, it will rarely penetrate the entire cross section of a wood item.

To ensure maximum protection, whenever possible cut lumber and plywood to size before having it custom treated. If cuts or holes have to be made in treated material, the cut surface must be double brushed with a suitable preservative such as copper naphthenate. During subsequent construction, always organize your sawing so that the cut surface after brush treatment is not in contact with the ground.

Wood pressure treated with chromated copper arsenate (CCA) or ammoniacal copper arsenate (ACA) can be stained or painted. As with untreated wood, the paint or stain will only perform well if the preservative-treated wood is dry and free from dirt or other deposits before the finish is applied. Freshly treated material must, therefore, be kiln dried before use, if it is to be painted or stained immediately. With ACA-treated wood, the ammonia used can sometimes be retained for a long time following treatment, so advice should be sought before application of the finish.

In any construction, the life obtained is determined by the part which fails first. Now that you have doubled or trebled the life of the wood through preservation, it is important to remember the bolts, nails, screws and fasteners which hold it all together. Ordinary iron will corrode (rust) and should not be used. Instead, use hot-dipped galvanized or stainless steel.

Finally, a few points on the safe handling of wood. When sawing large quantities of wood (untreated or treated), wear a dust mask, since the fine sawdust produced can irritate the nose and throat. Maintain clean and tidy work habits. Wash hands before eating. Store chemical solutions, such as stains and preservatives, in clearly marked containers away from foodstuffs and out of the reach of children. Do not burn pressure-treated wood. Instead, residual scraps of CCA or ACA-treated wood and sawdust should be disposed of as landfill.

APPENDIX 1. TREATING PLANTS IN WESTERN CANADA

Plant	Location	Preservative used*	Products treated	Policy on selling treated products
BRITISH COLUMBIA				
A & A Post and Rail (D)	Kamloops	PCP	Rails, posts	Dip treatment
Ainsworth Lumber	Clinton	CCA	Lumber, siding, posts	Custom treating
Bell Pole Co. Ltd. (T)	Lumby	PCP, CREO	Poles	Do custom treating, mainly for utilities
B.C. Clean Wood Preservers Ltd.	Surrey	CCA	All products	Custom work
Canada Cedar Pole Preservers (T)	Galloway	PCP	Poles, posts	Custom work
Domtar Chemicals Ltd.	New Westminster	PCP	All products	Do large custom orders (20 + M fbm); sell to building supply stores.
Domtar Chemicals Ltd.	Prince George	PCP	All products	- do -
Dura Wood Preservers Ltd.	Surrey	PCP, CuNaph	All products	Custom work; no minimum order; post inventory maintained; sell to building supply stores
Kootenay Wood Preservers	Cranbrook	CCA	Posts, railing, piling	Products sold at plant
Koppers International Canada Ltd.	Burnaby	CCA, PCP, CREO	All products	Custom work (minimum order $100); sell to building supply stores
MacGillis and Gibbs (T)	Terrace	PCP	Poles	Supply utilities mainly
MacMillan Bloedel Pole & Piling Division	New Westminster	ACA	Poles and piling	Supply utilities mainly
Pacific Wood Preservers Ltd.	Surrey	CCA	Siding, fencing, posts, shakes, plywood	Custom treating
Prince George Wood Preservers	Prince George	CCA	Posts, poles, plywood	Custom treating; sell to building supply stores
Princeton Wood Preservers	Princeton	PCP	Posts	Retail through "Ronco" fencing outlets.

Plant	Location	Preservative used*	Products treated	Policy on selling treated products
ALBERTA				
Bell Pole Co. Ltd. (T)	Calgary	PCP	Poles	Mainly treat for utilities
Branch Pole Co. Ltd.	Edson	PCP	Posts	Available at plant by the bundle
Domtar Chemicals Ltd.	Cochrane	PCP, CREO	All products	Large custom orders; sell to building-supply stores
Domtar Chemicals Ltd.	Edmonton	PCP, CREO, ACA	All products	- do -
Dunmore Wood Preservers (D)	Dunmore	PCP	Posts	Cash and carry at plant
Koppers International Canada Ltd.	Camrose	CCA, PCP	All products	Sell to building supply stores
Monkman Pass Wood Products Ltd.	Beaverlodge	CCA	Fenceposts, lumber	
Natal Forest Products Ltd.	Coleman	PCP	Posts and poles	Products sold through distributor
Peerless Wood Preservers Ltd.	Cayley	PCP	Posts, poles, lumber	Products sold at plant; inventory of posts and treated lumber maintained.
Rocky Wood Preservers Ltd.	Rocky Mountain House	PCP, CCA	Posts, poles, lumber	Products sold at plant and to building-supply stores.
SASKATCHEWAN				
B and B Wood Preservers Ltd.	Meadow Lake	PCP, CCA	Posts	Products sold at plant
C.J. Andres & Son Treated Poles	Christopher Lake	PCP	Posts, poles, railing	Products sold at plant
Cote Wood Industries	Kamsack	CCA	Posts	Cash and carry from plant
Domtar Chemicals Ltd.	Prince Albert	PCP, CREO	All products	Large custom orders; sell to building supply stores

Plant	Location	Preservative used*	Products treated	Policy on selling treated products
L. & M. Wood Products	Glaslyn	PCP, CCA	Posts and poles	Sold at the plant or through building supply stores
Langford & Son Wood Preservers	Prince Albert	PCP	Posts	Products sold at plant
Lehner Wood Preservers	Prince Albert	PCP	Posts	Sold at the plant by the bundle
Northern Wood Preservers (Sask.) Ltd.	Prince Albert	CREO, PCP	Poles, fenceposts	Unknown
Saskatchewan Forest Products Corp.	Prince Albert	CCA, PCP	All products	Some custom work
Sumners Wood Preservers	Christopher Lake	PCP	Posts, railing	Products sold at plant
MANITOBA				
Manitoba Forest Resources Ltd.	The Pas	CCA	Posts, poles, lumber	Unknown
Prendiville Timber Preservers Ltd.	Neepawa	CCA	Posts, poles, lumber	Products sold at plant; inventory of lumber and posts maintained
Roblin Forest Products Ltd.	Roblin	CCA	Posts, poles, lumber	Custom work; products sold at plant

*CCA = Chromated copper arsenate

CREO = Creosote

CuNaph = Copper naphthenate

D = Cold dip treatment

PCP = Pentachlorophenol

ACA = Ammoniacal copper arsenate

T = Thermal treatment (hot and cold bath)